JC09 Rec'd PCT/PTO 07 MAR 2001 CT
09/786553

LAW OFFICES
SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC
2100 PENNSYLVANIA AVENUE, N.W.
WASHINGTON, DC 20037-3213
TELEPHONE (202) 293-7060
FACSIMILE (202) 293-7860
www.sughrue.com

OIPE JC157 MAR 07 2001 PATENT & TRADEMARK OFFICE

March 7, 2001

BOX PCT

Commissioner for Patents
Washington, D.C. 20231

PCT/FR00/01943
-filed July 6, 2000

Re: Application of Cedric LAPAILLE, Guillaume CALOT
A METHOD OF ESTIMATING THE SIGNAL-TO-NOISE RATIO IN A TELECOMMUNICATIONS RECEIVER AND AN APPLICATION OF THE METHOD TO CONTROLLING A TRANSMITTER
Our Ref: Q63090

Dear Sir:

The following documents and fees are submitted herewith in connection with the above application for the purpose of entering the National stage under 35 U.S.C. § 371 and in accordance with Chapter I of the Patent Cooperation Treaty:

☑ an executed Declaration and Power of Attorney.

☑ a copy of the International Application.

☑ 1 sheet of drawings.

☐ an English translation of Article 19 claim amendments.

☐ an English translation of Article 34 amendments (annexes to the IPER).

☑ an executed Assignment and PTO 1595 form.

☑ an Information Disclosure Statement with Form PTO-1449 listing the ISR references, and a complete copy of each reference.

☑ a Preliminary Amendment

It is assumed that copies of the International Application, the International Search Report, the International Preliminary Examination Report, and any Articles 19 and 34 amendments as required by § 371(c) will be supplied directly by the International Bureau, but if further copies are needed, the undersigned can easily provide them upon request.

PLEASE SEE THE ATTACHED PRELIMINARY AMENDMENT BEFORE CALCULATING THE FEE:

The Government filing fee is calculated as follows:

Total claims	15	-	20	=		x	$18.00	=	$.00
Independent claims	1	-	3	=		x	$80.00	=	$.00
Base Fee									$860.00
TOTAL FEE									$860.00

A check for the statutory filing fee of $860.00 is attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 19-4880. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16, 1.17 and 1.492 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

Priority is claimed from July 08, 1999 based on French Application No. 9908842.

Respectfully submitted,

David J. Cushing
Registration No. 28,703

SUGHRUE, MION, ZINN,
MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, D.C. 20037-3213
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

Date: March 7, 2001

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	PCT/FR00/01943
Cedric LAPAILLE, et al.	Attorney Docket Q63090
Appln. No.: Unknown	Group Art Unit: Unknown
Confirmation No.: Not assigned	Examiner: Unknown
Filed: March 07, 2001	

For: A METHOD OF ESTIMATING THE SIGNAL-TO-NOISE RATIO IN A TELECOMMUNICATIONS RECEIVER AND AN APPLICATION OF THE METHOD TO CONTROLLING A TRANSMITTER

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Page 1, after the title, insert the heading:

BACKGROUND OF THE INVENTION

Page 2, after line 23, insert the heading:

SUMMARY OF THE INVENTION

Page 6, after line 4, insert the heading:

BRIEF DESCRIPTION OF THE DRAWINGS

after line 15, insert the heading:

DETAILED DESCRIPTION OF THE INVENTION

IN THE CLAIMS:

Please enter the following amended claims:

3. (Amended) A method according to claim 1, characterized in that, to filter the noise signal, the statistical distribution of the noise power measurements is observed for a particular period (T) during which a statistically representative number of measurement samples is collected and which is sufficiently short for the noise to remain practically stationary.

5. (Amended) A method according to claim 3, characterized in that the noise value used is the maximum value over the particular period (T).

6. (Amended) A method according to claim 3, characterized in that the moments of the distribution are determined.

8. (Amended)A method according to claim 1, characterized in that a finite or infinite impulse response low-pass filter is used to filter the noise signal.

9. (Amended)A method according to claim 1, characterized in that a finite impulse response filter is used to filter the wanted signal (E_b).

11. (Amended)A method according to claim 9, characterized in that the transmitter provides a reference signal with a regular period at a particular level and the signal-to-noise ratio is estimated from that reference signal.

12. (Amended)A method according to claim 1, characterized in that an infinite impulse response filter is used to filter the estimate of the wanted signal.

14. (Amended)A method according to claim 12 , characterized in that packets or cells are received sporadically and each packet or cell received is filtered.

15. (Amended)An application of the method according to claim 1 to estimating the signal-to-noise ratio in a telecommunications receiver sending data for controlling the power of a corresponding transmitter.

IN THE ABSTRACT:

Please add the following Abstract:

ABSTRACT

The invention occurs a method for estimating a signal-to-noise ratio, in particular digital, received by a radio communication receiver. Said method is characterised in that it consists in estimating separately the signal and the noise and in filtering (36, 44) separately the signal (E_b) and the noise (N_0) before carrying out the division (40) of the signal from the noise. The noise filtering is for example of the statistical type, whereas the signal filtering is of the low-pass filtering type.

AMENDMENT
Attorney Docket Q63090

REMARKS

Entry and consideration of this Amendment is respectfully requested.

Respectfully submitted,

David J. Cushing
Registration No. 28,703

SUGHRUE, MION, ZINN,
MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, D.C. 20037-3213
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

Date: March 7, 2001

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 1, after the title, insert the heading:

BACKGROUND OF THE INVENTION

Page 2, after line 23, insert the heading:

SUMMARY OF THE INVENTION

Page 6, after line 4, insert the heading:

BRIEF DESCRIPTION OF THE DRAWINGS

after line 15, insert the heading:

DETAILED DESCRIPTION OF THE INVENTION

IN THE CLAIMS:

The claims are amended as follows:

3. (Amended) A method according to claim 1~~ or claim 2~~, characterized in that, to filter the noise signal, the statistical distribution of the noise power measurements is observed for a particular period (T) during which a statistically representative number of measurement samples is collected and which is sufficiently short for the noise to remain practically stationary.

5. (Amended) A method according to claim 3~~ or claim 4~~, characterized in that the noise value used is the maximum value over the particular period (T).

6. (Amended) A method according to claim 3~~ or 4~~, characterized in that the moments of the distribution are determined.

8. (Amended)A method according to claim 1~~ or claim 2~~, characterized in that a finite or infinite impulse response low-pass filter is used to filter the noise signal.

9. (Amended)A method according to~~ any preceding~~ claim 1, characterized in that a finite impulse response filter is used to filter the wanted signal (E_b).

11. (Amended)A method according to claim 9~~ or claim 10~~, characterized in that the transmitter provides a reference signal with a regular period at a particular level and the signal-to-noise ratio is estimated from that reference signal.

12. (Amended)A method according to ~~any of claims 1 to 8~~claim 1, characterized in that an infinite impulse response filter is used to filter the estimate of the wanted signal.

14. (Amended)A method according to claim 12 ~~or claim 13~~, characterized in that packets or cells are received sporadically and each packet or cell received is filtered.

15. (Amended)An application of the method according to ~~any preceding~~ claim 1 to estimating the signal-to-noise ratio in a telecommunications receiver sending data for controlling the power of a corresponding transmitter.

IN THE ABSTRACT OF DISCLOSURE:

A new Abstract has been added. Please see section above.

09/786553
F° 102319 SH/SPD
JC02 Rec'd PCT/PTO 07 MAR 2001

A METHOD OF ESTIMATING THE SIGNAL-TO-NOISE RATIO IN A TELECOMMUNICATIONS RECEIVER AND AN APPLICATION OF THE METHOD TO CONTROLLING A TRANSMITTER

The invention relates to a method of estimating the signal-to-noise ratio of a signal received by a radiocommunications receiver. It also relates to a receiver for implementing the method and to an application of the method to controlling the power of a transmitter.

A telecommunications system generally transmits a large number of different calls simultaneously.

By way of example, the telecommunications system considered herein is one in which terminals communicate with a control or connection station, in particular via retransmission means on a satellite. Calls between terminals are effected via the control station. The control station therefore communicates simultaneously with a set of terminals.

In the above telecommunications system, the number of calls that can be transmitted simultaneously depends on the retransmission power available on the satellite. To maximize the capacity of the system, in other words to maximize the number of calls that can be transmitted simultaneously, it is necessary to minimize the power allocated to each transmitter, because the retransmission power is necessarily limited. However, this constraint is difficult to reconcile with the requirement to optimize call quality, which requires sufficient transmission power. As a general rule, the calls are digital calls and transmission quality is assessed against a maximum permitted error rate. The permitted error rate is guaranteed if the received signal-to-noise ratio is above a pre-determined threshold.

Thus the power of a transmitter is generally determined from the signal-to-noise ratio measured at the associated receiver and the signal-to-noise ratio is generally measured continuously, in particular in a

satellite transmission system, because propagation conditions can vary, in particular because of variations in meteorological conditions. For example, rain causes strong attenuation of the received signal compared to transmission in fine weather. Propagation conditions can also be degraded by scintillation due to multiple signal paths causing additive and subtractive combination of signals. Propagation conditions can also be degraded because of masking when an antenna is tracking a mobile source (here the satellite) and obstacles block the path of the transmitted signal.

The measured signal-to-noise ratio of a received signal is itself generally subject to estimation noise and the measurements are usually smoothed, for example by low-pass filtering, to reduce the estimation noise.

The accuracy of the measured signal-to-noise ratio determines the capacity of the telecommunications system. If the measurement is accurate, each transmitter is allocated just the necessary power, which therefore maximizes the communications resources, whereas an inaccurate measurement leads to the allocation of too much power to each transmitter, which is not favorable to maximizing communications capacity.

The invention improves the accuracy of the estimated signal-to-noise ratio and thus supplies a set point signal to the associated transmitter which minimizes the power it transmits.

To this end, the invention estimates the signal and the noise separately and the signal and the noise are filtered separately before dividing signal by noise. It has been found that filtering each component separately prior to division reduces the estimation noise.

In one embodiment, the signal and the noise are filtered differently, preferably in ways that are respectively suited to the signal and to the noise. The signal and the noise are variables of different kinds, in particular because of their different physical origins,

and so a form of processing suited to one of the variables is not necessarily suited to the other one, for example, because their amplitudes and frequency bands are usually very different.

Also, when the traffic is sporadic, the power of the signal can be estimated only when data signals are present, although noise can be measured continuously.

A low-pass filter is preferably used to filter the wanted signal prior to division, on the one hand to achieve a significant reduction in the signal estimation noise and on the other hand to achieve a sufficiently short control loop response time. To this end, either a finite impulse response filter is used, for example an averaging filter, or an infinite impulse response filter is used, for example a first order filter. A first order infinite impulse response filter is preferable in the case of sporadic traffic because it gives more weight to more recent data than to less recent data.

Statistical smoothing that allows for the random nature of the noise is preferably used to filter or smooth the noise estimate. To this end, the statistical distribution of the noise power measurements is observed over a particular period chosen to be long enough to collect a large (statistically representative) number of measurements but such that the noise retains a static behavior during that period. A noise level above the average value is then chosen to constitute a limit value beyond which the probability of the estimated noise power exceeding that limit during the observation period is below a low threshold ε.

In other words, to estimate the noise, instead of calculating an average value, a histogram of noise levels is considered and the spread of the noise levels is determined.

In the simplest case, the highest noise level over a suitably long observation period is chosen, for example a period of the order of one second.

The noise level can also be estimated as a function of known parameters of the noise. For example, if it is known that the noise is Gaussian noise, the average μ and the variance σ^2 of the distribution are calculated and the smoothed value is $\mu + n\sigma$, where σ is a standard deviation and $\underline{n}$ is an integer such that the probability of the noise power not exceeding the value $\mu + n\sigma$ is less than the low threshold ε.

More generally, the average and the variance, i.e. the moments of the distribution, are used to estimate the noise power.

Statistical smoothing of the estimate is particularly beneficial in the event of jamming.

It is also possible to use a low-pass finite or infinite impulse response noise filter, for example in the presence of thermal noise.

The present invention applies primarily to estimating the signal-to-noise ratio of a wanted signal, i.e. of a data signal.

The present invention provides a method of estimating the signal-to-noise ratio of a wanted signal, in particular a digital signal, received by a radiocommunications receiver. The method is characterized in that, to minimize the estimation noise of the signal-to-noise ratio, the signal and the noise are estimated separately and the signal and the noise are filtered separately before division of the signal by the noise.

In an embodiment the filtering of the wanted signal is different from the filtering of the noise signal.

In an embodiment, to filter the noise signal, the statistical distribution of the noise power measurements is observed for a particular period during which a statistically representative number of measurement samples is collected and which is sufficiently short for the noise to remain practically stationary.

In another embodiment the noise level used has a

value such that the probability that the noise level exceeds that value is less than a predetermined threshold during the observation period.

In an embodiment the noise value used is the maximum value over the particular period.

In an embodiment the moments of the distribution are determined.

In an embodiment the average and the variance of the distribution are determined and the noise value used is $\mu + n\sigma$, where σ is a standard deviation and n is a number determined according to the predetermined threshold.

In an embodiment a finite or infinite impulse response low-pass filter is used to filter the noise signal.

In an embodiment a finite impulse response filter is used to filter the wanted signal.

In an embodiment the finite impulse response filter is an averaging filter.

In an embodiment the transmitter delivers a reference signal with a regular period at a particular level and the signal-to-noise ratio is estimated from that reference signal.

In an embodiment an infinite impulse response filter is used to filter the estimate of the wanted signal.

In an embodiment a first order auto-regressive filter is used, for example, as expressed by the equation:

$$\hat{x}_i = (1-a)\tilde{x}_i + a\hat{x}_{i-1}$$

where $\tilde{x}_i$ represents the instantaneous estimate of the wanted signal at time i, $\hat{x}_i$ represents the smoothed estimate of the wanted signal at time i and a is an integration coefficient.

In an embodiment packets or cells are received sporadically and each packet or cell received is filtered.

The invention also provides an application of the

method according to the invention to estimating the signal-to-noise ratio in a telecommunications receiver sending data for controlling the power of a corresponding transmitter.

Other features and advantages of the invention will become apparent on reading the following description of embodiments of the invention, which description is given with reference to the accompanying drawings, in which:

Figure 1 is a diagram of a transmitter and a receiver using the method according to the invention,

Figure 2 is a diagram of a telecommunications system to which the method according to the invention is applied, and

Figure 3 is a diagram explaining some aspects of the filtering used in the receiver shown in Figure 1.

Figure 1 shows a transmitter 10 and a receiver 12. The power P_e of the transmitter 10 is determined by a set point signal δP_e supplied by the receiver 12.

In the example, the transmitter and the receiver are parts of a telecommunications system in which calls are transmitted via non-geostationary satellites 14 (Figure 2) in low or medium Earth orbit, at an altitude of the order of 1 450 km in the example. The Earth is divided into areas 16 each of which is 700 km in diameter, for example, and each area 16 includes a control or connection station 18, which is centrally located therein, for example, and a plurality of terminals 20_1, 20_2, etc. The connection station 18 is connected to one or more other networks 22, for example terrestrial networks.

A call between two terminals 20_1 and 20_2 is effected via the satellite 14 and the station 18. To be more precise, when the terminal 20_1 is communicating with the terminal 20_2, the signal transmitted by the terminal 20_1 is transmitted to the station 18 via the satellite 14 and the station 18 forwards the signal to the terminal 20_2, also via the satellite 14. By "satellite" is meant the

retransmission means on board the satellite, of course.

Likewise, a call between a terminal 20_1 and a subscriber of the network 22 is effected via the station 18. In other words, when a subscriber of the network 22 calls the subscriber 20_1, the signal is transmitted to the station 18 which transmits it to the terminal 20 via the satellite 14.

Each terminal is simultaneously a transmitter and a receiver and the connection station 18 also transmits and receives simultaneously. Thus, in Figure 1, the transmitter 10 is either in a terminal or in the connection station 18 and the receiver 12 is likewise in the station 18 or in a terminal 20_i.

A signal transmitted by the transmitter 10 propagates in space, which constitutes a channel 28 (Figure 10) which attenuates the signal and introduces noise.

In the conventional way, the receiver 12 includes a receiver unit 30, a unit 32 for estimating the power E_b of the signal and a unit 34 for estimating the power N_0 of the noise.

In the invention, the signal estimator unit 32 is followed by a signal filter unit 36 downstream of a divider 40. In other words, the output of the unit 36 is connected to the numerator input 42 of the divider 40.

The noise power N_0 estimator unit 34 is followed by a filter 44 downstream of the divider 40 whose output is connected to the denominator input 46 of the divider 40.

The divider 40 supplies an estimate of the signal-to-noise ratio to a decision unit 50 which has an input 52 to which a reference signal γ_{ref} is applied. The signal supplied by the divider 40 and the reference signal applied to the input 52 are compared to generate a set point δP_e for adjusting the power of the transmitter 10.

As an alternative to this (not shown), the decision unit is in the transmitter and the receiver transmits the

signal-to-noise ratio (the output from the divider 40) to a control input of the transmitter.

Consider first the situation in which the transmitter 10 is in the connection station 18 and the receiver 12 is in a terminal 20_i. In this situation, measuring the signal-to-noise ratio is facilitated by the transmission of a periodic reference signal from the station 18 to the terminals 20_i. This is a synchronization signal of particular level and known period. Accordingly, in this case, the receiver 12 can use the synchronization signal to measure the signal-to-noise ratio, instead of using the wanted signals, which are by nature sporadic.

In this case, the filter 36 for the wanted signal can be a simple averaging circuit performing the following operation:

$$\hat{x}_i = \frac{1}{L}\sum_{j=0}^{L-1}\tilde{x}_{i-j}$$

where $\tilde{x}_i$ represents the instantaneous estimate of E_b at time $\underline{i}$, $\hat{x}_i$ represents the smoothed estimate of E_b at time $\underline{i}$ and L is the integration length.

In this example, the filter 44 samples the noise signal N_0 with a period of 1.5 ms over a time period of a few seconds and takes the maximum value observed during that time period.

As an alternative to this, over a particular time period T, chosen to be sufficiently long to collect a sufficient number of measured values but sufficiently short to guarantee stationary noise behavior, the parameters associated with the distribution (histogram) of the noise samples are calculated to deduce therefrom a noise level $\mu_{N0} + \Delta_{N0}$ such that the probability that the instantaneous noise value exceeds that level is less than ε, in other words:

$$P(\forall i \in [0,T],\ \tilde{N}_0(i) > \mu_{N0} + \Delta_{N0}) < \varepsilon$$

In the above equation, $\tilde{N}_0(i)$ represents the value of

a noise sample of the distribution at time t_i, T the observation period and μ_{N0} the average value of the noise signal.

The above equation is represented by the Figure 3 diagram, in which the instantaneous noise levels $\tilde{N}_0$ are plotted on the abscissa axis and the probability $p(\tilde{N}_0)$ of appearance of those levels on the ordinate axis.

The value adopted $\mu_{N0} + \Delta_{N0}$ can be calculated using moments of the distribution, in particular the average μ and the variance σ^2. In this latter case, the smoothed value is $\mu + n\sigma$, for example, where σ is a standard deviation and n is an integer chosen according to the value of ε adopted.

Then consider the situation in which the transmitter 10 is in a terminal and the receiver is in the connection station 18. In this case, the terminal does not send any periodic reference signal to the connection station, only sporadic data signals in the form of cells or packets, and the signal power E_b is estimated in the receiver for each packet or cell. The noise can be estimated with a regular period, as in the previous situation.

Accordingly, in this case, the filtering 44 of the noise is effected in the same manner as under the previous hypothesis. On the other hand, it is preferable to allow for the sporadic nature of the transmission in smoothing or filtering the signal (36). A first order auto-regressive filter is used to perform the following operation, for example:

$$\hat{x}_i = (1-a)\tilde{x}_i + a\hat{x}_{i-1}$$

where $\tilde{x}_i$ represents the instantaneous estimate of E_b at time i, $\hat{x}_i$ represents the smoothed estimate of E_b at time i and a is an integration coefficient.

A filter of the above kind is better suited to the sporadic nature than an average because, as shown by the preceding equation, it gives more weight to more recent data than to less recent data.

The method according to the invention provides an

estimate of the signal-to-noise ratio of the received signal enabling a set point to be applied to the transmitter. It is therefore possible to minimize the power transmitted whilst conforming to a bit error rate that does not exceed a prescribed threshold.

The above statistical processing of the noise is particularly beneficial and efficient in a situation in which the telecommunications system shown in Figure 2 has two adjoining areas 16 using the same carrier frequency. In this case there is a risk of jamming in neighboring or non-neighboring parts of the two areas and therefore of unpredictable noise in those parts.

CLAIMS

1. A method of estimating the signal-to-noise ratio of a wanted signal, in particular a digital signal, received by a radiocommunications receiver, characterized in that, to minimize the estimation noise of the signal-to-noise ratio, the signal and the noise are estimated separately and the signal (E_b) and the noise (N_0) are filtered (36, 44) separately before division (40) of the signal by the noise.

2. A method according to claim 1, characterized in that the filtering (36) of the wanted signal (E_b) is different from the filtering (44) of the noise signal (N_0).

3. A method according to claim 1 or claim 2, characterized in that, to filter the noise signal, the statistical distribution of the noise power measurements is observed for a particular period (T) during which a statistically representative number of measurement samples is collected and which is sufficiently short for the noise to remain practically stationary.

4. A method according to claim 3, characterized in that the noise level used has a value ($\mu_{N0} + \Delta_{N0}$) such that the probability (P) that the noise level exceeds that value is less than a predetermined threshold (ε) during the observation period (T).

5. A method according to claim 3 or claim 4, characterized in that the noise value used is the maximum value over the particular period (T).

6. A method according to claim 3 or claim 4, characterized in that the moments of the distribution are determined.

7. A method according to claim 6, characterized in that

the average (μ) and the variance (σ^2) of the distribution are determined and in that the noise value used is $\mu + n\sigma$, where σ is a standard deviation and n is a number determined according to the predetermined threshold.

8. A method according to claim 1 or claim 2, characterized in that a finite or infinite impulse response low-pass filter is used to filter the noise signal.

9. A method according to any preceding claim, characterized in that a finite impulse response filter is used to filter the wanted signal (E_b).

10. A method according to claim 9, characterized in that the finite impulse response filter is an averaging filter.

11. A method according to claim 9 or claim 10, characterized in that the transmitter provides a reference signal with a regular period at a particular level and the signal-to-noise ratio is estimated from that reference signal.

12. A method according to any of claims 1 to 8, characterized in that an infinite impulse response filter is used to filter the estimate of the wanted signal.

13. A method according to claim 12, characterized in that a first order auto-regressive filter is used, for example, as expressed by the equation:

$$\hat{x}_i = (1-a)\tilde{x}_i + a\hat{x}_{i-1}$$

where $\tilde{x}_i$ represents the instantaneous estimate of the wanted signal at time i, $\hat{x}_i$ represents the smoothed estimate of the wanted signal at time i and a is an integration coefficient.

14. A method according to claim 12 or claim 13, characterized in that packets or cells are received sporadically and each packet or cell received is filtered.

15. An application of the method according to any preceding claim to estimating the signal-to-noise ratio in a telecommunications receiver sending data for controlling the power of a corresponding transmitter.

A B S T R A C T

A METHOD OF ESTIMATING THE SIGNAL-TO-NOISE RATIO IN A TELECOMMUNICATIONS RECEIVER AND AN APPLICATION OF THE METHOD TO CONTROLLING A TRANSMITTER

The invention concerns a method of estimating the signal-to-noise ratio of a wanted signal, in particular a digital signal, received by a radiocommunications receiver. The method is characterized in that the signal and the noise are estimated separately and the signal (E_b) and the noise (N_0) are filtered (36, 44) separately before division (40) of the signal by the noise. The filtering of the noise is statistical filtering, for example, and the filtering of the signal is low-pass filtering.

Translation of the title and the abstract as they were when originally filed by the Applicant. No account has been taken of any changes that may have been made subsequently by the PCT Authorities acting <u>ex officio</u>, e.g. under PCT Rules 37.2, 38.2, and/or 48.3.

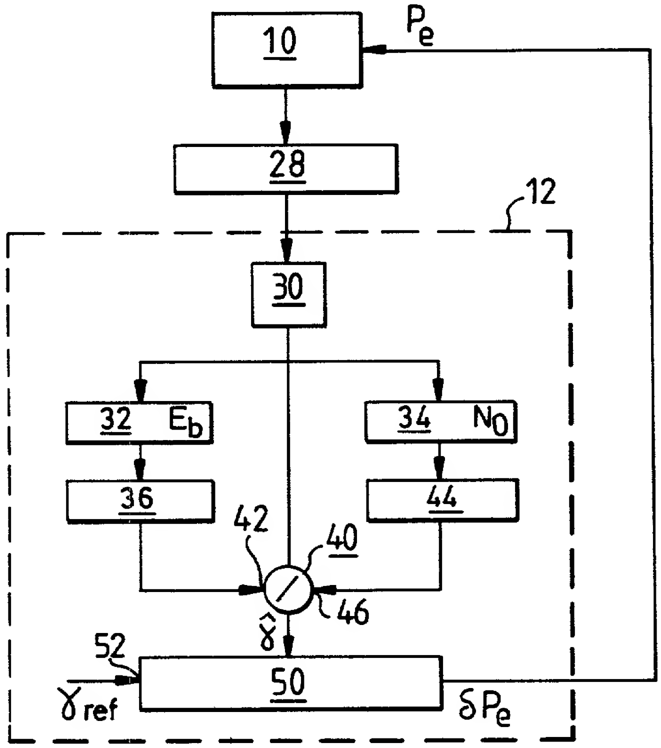

FIG.1

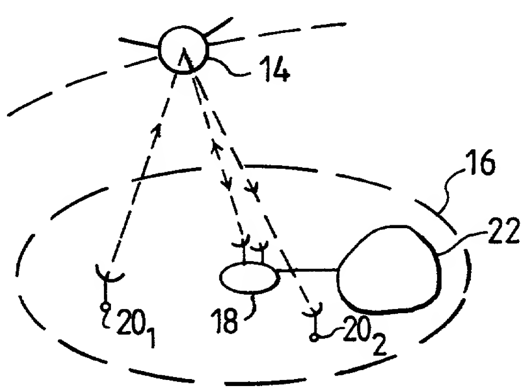

FIG.2

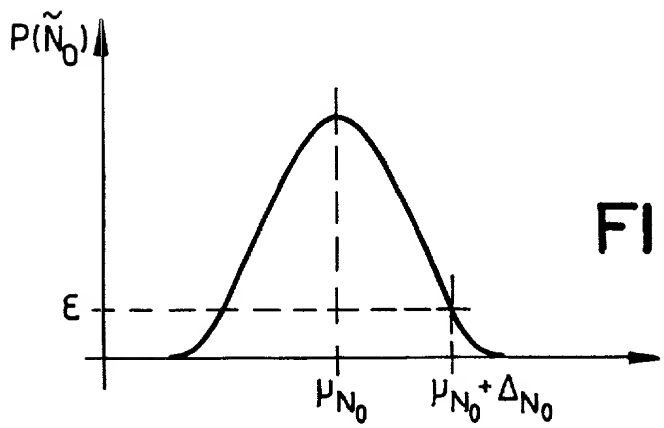

FIG.3

Declaration and Power of Attorney for Patent Application

Déclaration et Pouvoirs pour Demande de Brevet

French Language Declaration

En tant que l'inventeur nommé ci-après, je déclare par le présent acte que:

As a below named inventor, I hereby declare that:

Mon domicile, mon adresse postale et ma nationalité sont ceux figurant ci-dessous à côté de mon nom.

My residence, post office address and citizenship are as stated next to my name.

Je crois être le premier inventeur original et unique (si un seul nom est mentionné ci-dessous), ou l'un des premiers co-inventeurs originaux (si plusieurs noms sont mentionnés ci-dessous) de l'objet revendiqué, pour lequel une demande de brevet a été déposée concernant l'invention de la description identifiée par le numéro de référence

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention in the specification identified by Docket No.

102319/SH/SPD

Je déclare par le présent acte avoir passé en revue et compris le contenu de la description ci-dessus, revendications comprises.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims.

Je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

Je revendique par le présent acte avoir la priorité étrangère, en vertu du Titre 35, § 119(a)-(d) ou § 365(b) du Code des Etats-Unis, sur toute demande étrangère de brevet ou certificat d'inventeur ou, en vertu du Titre 35, § 365(a) du même Code, sur toute demande internationale PCT désignant au moins un pays autre que les Etats-Unis et figurant ci-dessous et, j'ai aussi indiqué ci-dessous toute demande étrangère de brevet, tout certificat d'inventeur ou toute demande internationale PCT ayant une date de dépôt précédant celle de la demande à propos de laquelle une priorité est revendiquée.

I hereby claim foreign priority under Title 35, United States Code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below, and have also identified below any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior foreign application(s) for which priority is claimed
Demande(s) de brevet étrangère(s) antérieure(s) dont la priorité est revendiquée

(Number) (Numéro)	(Country) (Pays)	(Day/Month/Year Filed) (Jour/Mois/Année de dépôt)
99 08 842	FRANCE	08 JULY 1999

Prior foreign applications for which priority is not claimed
Demande(s) de brevet étrangères antérieure(s) dont la priorité n'est pas revendiquée

(Number) (Numéro)	(Country) (Pays)	(Day/Month/Year Filed) (Jour/Mois/Année de dépôt)

French Language Declaration

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 119(e) du Code des Etats-Unis, de toute demande de brevet provisoire effectuée aux Etats-Unis et figurant ci-dessous.

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

(Application No.) (No de demande)	(Filing Date) (Date de dépôt)

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 120 du Code des Etats-Unis, de toute demande de brevet effectuée aux Etats-Unis, ou en vertu du Titre 35, § 365(c) du même Code, de toute demande internationale PCT désignant les Etats-Unis et figurant ci-dessous et, dans la mesure où l'objet de chacune des revendications de cette demande de brevet n'est pas divulgué dans la demande antérieure américaine ou internationale PCT, en vertu des dispositions du premier paragraphe du Titre 35, § 112 du Code des Etats-Unis, je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations, dont j'ai pu disposer entre la date de dépôt de la demande antérieure et la date de dépôt de la demande nationale ou internationale PCT de la présente demande.

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application No.) (N0 de demande)	(Filing Date) (Date de dépôt)	(Status)(patented, pending, abandoned) (Statut)(breveté, en cours d'examen, abandonné)

Je déclare par le présent acte que toute déclaration ci-incluse est, à ma connaissance, véridique et que toute déclaration formulée à partir de renseignements ou de suppositions est tenue pour véridique; et de plus, que toutes ces déclarations ont été formulées en sachant que toute fausse déclaration volontaire ou son équivalent est passible d'une amende ou d'une incarcération, ou des deux, en vertu de la Section 1001 du Titre 18 du Code des Etats-Unis, et que de telles déclarations volontairement fausses risquent de compromettre la validité de la demande de brevet ou du brevet délivré à partir de celle-ci.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

French Language Declaration

POUVOIRS: En tant que l'inventeur cité, je désigne par la présente l'(les) avocat(s) et/ou agent(s) suivant(s) pour qu'ils poursuive(nt) la procédure de cette demande de brevet et traite(nt) toute affaire s'y rapportant avec l'Office des brevets et des marques: (mentionner le nom et le numéro d'enregistrement).

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: (list name and registration number)

24

John H. Mion, Reg. No. 18,879; Thomas J. Macpeak, Reg. No. 19,292; Robert J. Seas, Jr., Reg. No. 21,092; Darryl Mexic, Reg. No. 23,063; Robert V. Sloan, Reg. No. 22,775; ~~Peter D.~~ Olexy, Reg. No. 24,513; J. Frank Osha, Reg. No. 24,625; Waddell A. Biggart, Reg. No. 24,861; Louis Gubinsky, Reg. No. 24,835; ~~Neil B.~~ Siegel, Reg. No. 25,200; David J. Cushing, Reg. No. 28,703; John R. Inge, Reg. No. 26,916; ~~Joseph J.~~ Ruch, Jr., Reg. No. 26,577; Sheldon I. Landsman, Reg. No. 25,430; Richard C. Turner, Reg. No. ~~29,710~~; Howard L. Bernstein, Reg. No. 25,665; Alan J. Kasper, Reg. No. 25,426; Kenneth J. Burchfiel, Reg. No. 31,333; Gordon Kit, Reg. No. 30,764; ~~Susan J.~~ Mack, Reg. No. 30,951; Frank L. Bernstein, Reg. No. 31,484; Mark Boland, Reg. No. 32,197; William H. Mandir, Reg. No. 32,156; Scott M. Daniels, Reg. No. 32,562; Brian W. Hannon, Reg. No. 32,778; Abraham J. Rosner, Reg. No. ~~33,276~~; Bruce E. Kramer, Reg. No. 33,725; Paul F. Neils, Reg. No. 33,102; and Brett S. Sylvester, Reg. No. 32,765; and Robert M. Masters, Reg. No. 35,603.

Adresser toute correspondance à:

Send Correspondence to:
SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W., Suite 800
Washington, D.C. 20037-3213

Nom complet de l'unique ou premier inventeur	Full name of sole or first inventor (First Middle Last) Cédric LAPAILLE
Signature de l'inventeur Date	Inventor's signature Date 8/01/2001
Domicile	Residence 78400 CHATOU, FRANCE FX
Nationalité	Citizenship French
Adresse postale	Post Office Address 7, allée des Chevaux-Rû 78400 CHATOU, FRANCE
Nom complet du second co-inventeur, le cas échéant	Full name of second joint inventor, if any (First Middle Last) Guillaume CALOT
Signature du second inventeur Date	Second inventor's signature Date 15/02/2001
Domicile	Residence ~~78000 VERSAILLES,~~ 78150 Le Chesnay FRANCE
Nationalité	Citizenship French
Adresse postale	Post Office Address ~~28 rue Henri de Regnier 78000 VERSAILLES, FRANCE~~ 15, av. de Villars 78150 Le Chesnay FRANCE FX

(Fournir les mêmes renseignements et la signature de tout co-inventeur supplémentaire.)

(Supply similar information and signature for third and subsequent joint inventors.)